Exemption No. 7392

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Lufthansa Technik

For an exemption from § 25.785(b) of
Title 14, Code of Federal Aviation Regulations

Regulatory Docket No. 30151

GRANT OF EXEMPTION

By letters dated June 22, 2000, and August 29, 20000, Mr. Bernard Conrad, Senior VP Project and Development Engineering, Head of the JAA Approved Design Organisation, Lufthansa Technik AG, Postfach 63 03 00, D-22313 Hamburg, Germany petitioned for an exemption from the requirements of § 25.785(b) Title 14 Code of Federal Regulations (14 CFR). The proposed exemption, if granted, would permit relief from the general occupant protection requirements for multiple place side-facing seats on a Boeing Model 777-2AN airplane, serial number 29953.

The petitioner requests relief from the following regulation:

> Section 25.785(b), Amendment 25-64, requirements for general occupant protection for occupants of multiple place side-facing seats that are occupied during takeoff and landing.

The petitioner's supportive information is as follows:

> "Lufthansa Technik has been contracted by Saudi Oger for the completion of the interior and installation of miscellaneous passenger entertainment and supplemental systems of the Boeing Model 777-2AN aircraft MSN 29953. The airplane is currently registered in the Bermudas as VP-BRH. As the Bermuda Department of Civil Aviation has accepted

the FAA Type Certification for their national certification they are also requesting the issuance of an FAA supplemental type certificate (STC) for the VIP-completion.

“It has been agreed to use the validation process described in the recently concluded BASA Implementation Procedures Airworthiness, and we have applied for validation by the FAA of the respective LBA STC separately.

“The initial familiarization meeting took place on March 21 and 22, 2000 in New York, where it was determined that an exemption to 14 CFR 25. 785(b) would become necessary for the certification of the side facing seats installed.

“The purpose of this letter is to request an exemption from Title 14 CFR 25. 785(b), covering occupant general injury criteria, to permit the installation of side facing seats/divans manufactured by BE-AMP in the above mentioned airplane. This is due to the fact, that existing criteria for forward or aft facing seats do not provide an adequate level of safety for side-facing seats/divans. The same exemption has been requested from the German Luftfahrt-Bundesamt as the Primary Certification Authority for the STC.

“Background on Side Facing Seats:

“The FAA Memorandum, 'Side-Facing Seats on Transport Category Airplanes', dated 19 November 1997 and the FAA 'Draft Issue Paper: Petition for Exemption,' dated 12 November 1997, are recognized as they pertain to side-facing seats and divans. It is noted that these documents specify occupant protection criteria that are in addition to the requirements of 14 CFR 25.562. Body-to-Body Contact, Thoracic Trauma Index (TTI), Lateral Pelvic Acceleration, and Shoulder Strap Loading are additional occupant protection criteria introduced for side-facing passenger seats/divans. These additional occupant protection criteria are consistent with the current state-of-the-art pertaining to side-facing seat/divan design and installation certification.

“The FAA Memorandum proclaims, 'For multiple occupancy seating, the best criteria available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only means available for accepting these installations would be through an exemption from the general occupant protection requirements of § 25.785(b). Any petition for exemption must also, of course, address why a grant of the petition would be in the public interest, in accordance with § 11.25(b)(5).' The FAA Memorandum further states that the FAA's draft Issue Paper for side-facing divans is 'guidance material' that can be used to develop project-specific Issue Papers. Any side-facing seat/divan designed for installation into a Boeing 777-200 would therefore require establishment of a specific certification basis via the issue paper & exemption process.

“Supporting information:

“Supporting information regarding this petition for exemption including additional occupant protection criteria to be applied is attached to this letter. A copy of the cabin layout, in which the affected seats have been marked, is also attached. [available in the Docket]

“Public Interest:

“As in the case of the already established Exemptions No. 6820 and 6820A, granting this petition for exemption would be in the public interest as it allows efficient and safe carriage of Heads of State and executives in the sought for environment which would otherwise not be possible.

“Denial of this exemption would reduce the sales opportunities for the Boeing 777-200, because the typical and highly desirable VIP type configurations with private quarters and comfortable seating arrangements could no longer be realised.

“Granting the exemption furthermore would be in the interest of international harmonisation because other airworthiness authorities are considering requirements similar to those proposed in this petition for exemption.

“Conclusion:

“Lufthansa Technik believes that the arguments provided favor an exemption to permit the installation of side facing seats/divans in the Boeing 777 as described. We respectfully request that the FAA review this petition, and based upon compliance with the proposed additional occupant protection criteria issue an exemption to Title 14 CFR 25. 785(b) as requested."

“PROPOSED SIDE-FACING DIVAN CERTIFICATION CRITERIA

“1) Side-facing divans must meet the provisions of 14 CFR 25.562, Amendment 25-64, all sections.

“2) Occupant Retention: Acceptable occupant retention must be verified during dynamic testing of the divan. For the occupant seated in the forward-most seating position of a Single or multi-place divan, the pelvis must not translate past the structural forward edge of the divan when subjected to the dynamic test pulse prescribed in 14 CFR 25.562(b)(2).

“3) Body-to-Body Contact: Contact between the head, shoulder, torso, and/or pelvis of one Anthropomorphic Test Dummy (ATD) with an adjacent seated ATD is not allowed during the tests conducted in accordance with 14 CFR 25.562(b)(1) and (b)(2). Incidental contact of the feet, legs, arms, and/or hands that will not result in incapacitation of the occupants is acceptable. Contact during rebound is acceptable. Should multi-divan installations introduce longitudinal occupant centerline spacing lesser than was dynamically tested to satisfy this body-to-body contact criterion, additional substantiation will be required to assess body contact for this reduced occupant spacing.

“4) Thoracic Trauma Index (TTI): TTI for all side-facing occupants must be substantiated if occupant torso contact is present. Should occupant torso contact exist, TTI must be substantiated by dynamic test or rationale based upon previous testing of a

similar design/installation. When conducting a dynamic test to obtain a TTI value, an appropriate test device capable of recording a TTI value should be used. TTI must be less than 85g as defined by 49 CFR 572, Subpart F. If it can be shown from known occupant movement data that an occupant's torso will not be contacted up to the maximum test load, a TTI measurement is not required based on this absence of torso contact. Torso contact during rebound is acceptable.

"5) Lateral Pelvic Acceleration: Lateral pelvic acceleration for all side-facing occupants must be substantiated if contact with the occupant's pelvis is present. Should occupant pelvic contact exist, lateral pelvic acceleration must be substantiated by dynamic test or rationale based on previous dynamic testing of a similar design/installation. When conducting an actual test to obtain a lateral pelvic acceleration value, an appropriate test device capable of recording such a value should be used. The lateral pelvic acceleration for each occupant must not exceed 130g. Pelvic acceleration data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) Part 571.214, Section S6.13.5.

"6) Shoulder Strap Loads: Because 14 CFR 25.562(c)(1) is for crew seats only, shoulder strap (harness) loads are required to be measured for these side-facing divans capable of being occupied by passengers. Single strap tension loads must not exceed 1750 pounds per individual strap. If dual straps are used, the total strap tension load must not exceed 2000 pounds.

"7) Occupant Movement Envelope (OME): An OME must be established to be used for each occupant seated on the divan installation. The OME must account for a range of occupant sizes. The OME must encompass the movement of the ATD head, leading shoulder, torso, and pelvis. It must be increased in size to account for a range of occupant sizes. The OME must be referenced to a structural point on the divan that can further be referenced to an installation point on the aircraft. This reference point information is used to accurately position the OME to assess occupant protection for various installations. The OME establishes a "stay out zone" for satisfying occupant protection and body interaction criteria. Should one or more interior components be installed within the OME to predict occupant contact, substantiation for head strike and the occupant protection requirements identified in 2), 3), 4), and 5) is warranted.

"8) Required Structural Tests: The following structural tests are required for each side-facing divan configuration. Note that all seat positions of the divan are to be occupied for testing.

"1. Quantity one 14g minimum vertical test per 14. CFR 25.562(b)(1) with Hybrid II ATD(s)

"2. Quantity one 16g minimum longitudinal test per 14 CFR 25.562(b)(2) with Hybrid II ATD(s)

“3. To establish the OME, quantity one 16g minimum longitudinal test per 14 CFR 25.562(b)(2) without floor deformation, with zero degree yaw, and with Hybrid II ATD(s).

“9) Installation Testing: As noted above, should armrests, interior components, seats, and/or other divans be installed within the OME, substantiation of the body interaction and occupant protection criteria is warranted. To assess TTI, an appropriate Side Impact Dummy may be used that is capable of recording this value. Hybrid II ATDs may be used to assess Occupant Retention, Body-to Body Contact, Lateral Pelvic Acceleration, and HIC. The required installation testing is governed by each unique cabin arrangement. When substantiating TTI via an actual dynamic test with a Side Impact Dummy, a body-to body contact assessment can also be made during this test using the Side Impact Dummy. An additional test with a Hybrid II ATD is not required to assess the body-to-body contact for this installation. All tests are to be conducted with the divan installation fully occupied.

“10) Divan Installation Requirements: Due to the body-centered lap belt anchorages, the rear-most occupant on the divan installation will have a tendency to move past the rear end of the divan during the rebound phase of the dynamic event. To aid in the retention of the rear-most occupant of the divan installation, an end closure (armrest, bulkhead, cabinet, etc.) is required to be installed adjacent to the rear end of the divan installation. Because the rebound velocity of this occupant is low compared to the impact velocity, the potential for occupant injury is reduced during the rebound phase. Therefore, the end closure structure(s) need not be part of the divan nor can they be attached to the divan. Furthermore, the end closures need not be required to comply with the strength requirements of 14 CFR 25.562.

“11) Marking Requirements: Recent TSO authorizations for side-facing divans have been to TSO-C39b plus 14 CFR 25.562(a), (b). The occupant protection and installation requirements for these products have been established in the project specific Issue Papers. Installation approval is not part of the TSO approval and is recognized as being the responsibility of the installer using the Installation Limitations established for the divans. The marking requirements for these divans shall be consistent with the TSO letter established for the products by the FAA."

“BACKGROUND & CERTIFICATION METHODOLOGY

“Since the release of the FAA Memorandum and Draft Issue Paper in 1997, the industry has made substantial progress in the field of multi-place side-facing divan design and installation certification. Single and multiple occupancy side-facing seat/divan installations have been and are being certified for derivative and fully compliant aircraft. Project specific Issue Papers (or their equivalent) have been developed to establish the unique certification bases for these side-facing products due to the lack of published regulations. For side-facing seats/divans designed for installation into a fully compliant aircraft such as the Boeing 777-200, an Issue Paper is prescribed to provide the technical path for establishing the product certification basis. This issue Paper is then incorporated into a Petition for Exemption to 14 CFR 25.785(b) [or its foreign regulatory equivalent].

The Exemption, once granted, ultimately provides the certification path for the side-facing divan manufacturer and installer.

“Discussions with the FAA Transport Airplane Directorate personnel have led to the development of multi-place side-facing divan certification criteria more advanced than what was originally presented by the FAA in 1997. These certification criteria are specific to side-facing divans and are better suited to assess the structural and occupant protection capabilities of the divan installations. Further, they provide a means of creating installation limitations to be used by the divan installers. These installation limitations provide a means to assess the potential effects on occupant protection pertaining to specific cabin arrangements. The divan certification criteria are recognized by the FAA as being appropriate in lieu of the guidance criteria released in the 1997 Memorandum."

“Public Interest:

“Since the beginning of the era of VIP airplanes the installation of side facing multiple occupancy sofas has been used to create cabin interior configurations which would enable Heads of State and executives with a representative environment allowing formal and informal conferences and discussions in the same comfortable and elegant atmosphere they are used to in their homes, offices or palaces.

“Most if not all of the BBJ configurations addressed by Exemptions No. 6820 and 6820A do have side facing seats or sofas installed for the above reasons. However this fact did not need to be addressed as part of these Exemptions due to the difference in the certification basis of the Boeing 737-700 IGW as compared to the Boeing 777-200.

“Granting this Petition for Exemption would be in the public interest as it allows efficient and safe carriage of Heads of State and executives in the sought for environment which would otherwise not be possible.

“In absence of an exemption the number of passengers that can be carried under the mentioned conditions will be reduced, as the side-facing sofas then could only be occupied during flight, but not for taxi, takeoff and landing. In addition, denial of this exemption would reduce the sales opportunities for the Boeing 777-200, because the typical and highly desirable VIP type configurations with private quarters and comfortable seating arrangements could no longer be realised.

“Granting the exemption furthermore would be in the interest of international harmonisation because other airworthiness authorities have already agreed to requirements similar to those proposed in this petition for exemption.

“Lufthansa. Technik is firmly convinced that compliance with the proposed additional occupant protection criteria will assure safe carriage of passengers on side-facing multiple occupancy sofas. We respectfully request that the FAA review this petition and grant an exemption to Title 14 CFR 25.785(b) as requested."

A summary of the petition was published in the Federal Register on September 29, 2000 (65 FR 58594). No comments were received.

The Federal Aviation Administration's analysis/summary is as follows:

Background

The applicant's petition for exemption from § 25.785(b) is based on the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997. This memorandum provides dynamic test condition requirements and pass/fail criteria for side-facing seats on transport category airplanes.

The FAA Memorandum: Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides:

(1) The dynamic test conditions criteria. In terms of both pulse severity and types of tests currently required, these criteria are also considered directly applicable to side-facing seats. While it is true that the regulation was written with forward- and aft-facing seats in mind, the orientation of the seat does not change the relevant test conditions.

(2) The pass/fail criteria. For these criteria, however, the orientation of the seat may be significant. Injury criteria are currently limited to head, spine, and femur loads. Head impact is evaluated for contact experienced by the head against any aircraft interior installations, and the pass/fail criterion is based on the resultant head acceleration considering all axes of head motion. The lumbar spinal load is an axially compressive load that is primarily evaluated during the 14g, 60 degree test. The femur load is also compressive, and actually has not proved to be critical thus far. For a side-facing seat, other injury parameters may predominate such that evaluation of those parameters may be necessary to provide an acceptable level of safety.

The first consideration for a side-facing seat is the isolation of one occupant from another. That is, occupants should not rely on the impact with other occupants to provide energy absorption; body-to-body impacts are considered unacceptable.

The second consideration for a side-facing seat is the retention of occupants in the seat and restraint system. Addressing this concern may necessitate providing a means of restraint for the lower limbs as well as the torso. Failure to limit the forward (in the airplane’s coordinate system) travel of the lower limbs can cause the occupant to come out of the restraint system or produce severe injuries due to the resulting position of the restraint system, and/or twisting (torsional load) of the lower lumbar spinal column.

The third consideration for a side-facing seat is limiting the load in the torso in the lateral direction, where human tolerance differs from that for the forward- or aft-facing directions and where potential injury mechanisms exist. The automotive industry has developed test procedures and occupant injury criteria appropriate for side impact conditions. Their criteria involve limitation of lateral pelvic accelerations and use of the human tolerance parameter "Thoracic Trauma Index," which is defined in 49 CFR

§ 571.214. Use of the 49 CFR § 572, subpart F, Side Impact Dummy (SID), rather than the 49 CFR § 572, subpart B, Hybrid II Dummy used in the 14 CFR § 25.562 test, is required to evaluate these parameters. This is the best means available, at present, to assess the injury potential of a sideward impact condition. Such an evaluation is considered necessary to provide an acceptable level of safety for these types of seats.

Other potential injury mechanisms appropriate for aircraft seats may exist. However, due to the lack of useful injury criteria for those other potential injury parameters, such as neck loads and lower limb flail, the FAA is not able to specify criteria applicable to those areas at this time. The FAA considers that such criteria may be appropriate, particularly for multiple occupancy installations, and intends to pursue their further development.

For multiple occupancy seating, the best criteria currently available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only vehicle available for accepting these installations would be through an exemption from the general occupant protection requirements of § 25.785(a) prior to Amendment 25-72, or § 25.785(b) after Amendment 25-72.

The following summary of the criteria from the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides the basis of the petition for exemption.

1. Proposed Injury Criteria

(a) Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. Head injury criteria (HIC) assessments are only required for head contact with the seat and/or adjacent structures.

(b) Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one seated Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with §§ 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Contact during rebound is allowed.

(c) Body-to-Wall/furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

(d) Thoracic Trauma: Testing with a Side Impact Dummy (SID), as defined by 49 CFR part 572, subpart F, or its equivalent, must be conducted and Thoracic Trauma Index (TTI) injury criteria acquired with the SID must be less than 85, as defined in 49 CFR part 572, subpart F. Side impact dummy TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

(e) Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

(f) Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

2. General Guidelines

(a) All side-facing seats require end closures.

(b) All seat positions need to be occupied for the longitudinal tests.

(c) For the longitudinal tests, conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

(1) One test will be required with one SID ATD in the forward most position and Hybrid II ATD(s) in all other positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls).

(2) One test will be required with one SID ATD in the center seat and Hybrid II ATD(s) in all other positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

(d) For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's will be used in all seat positions.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not affect the level of safety provided by the regulations. Therefore, pursuant to the authority contained in § 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator

(14 CFR 11.53), Lufthansa Technik is hereby granted an exemption from the requirements of § 25.785(b), for the general occupant protection requirements for occupants of multiple place side-facing seats that are occupied during takeoff and landing for a Boeing Model 777-2AN airplane, serial number 29953.

The following limitations apply to this exemption:

1. The airplane must not be operated for hire, or offered for common carriage. This provision does not preclude the operator from receiving remuneration to the extent consistent with 14 CFR part 125 and 14 CFR part 91, subpart F, as applicable.

2. Existing Criteria: All injury protection criteria of §§ 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. The HIC assessments are only required for head contact with the seat and/or adjacent structures.

3. Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Any contact between adjacent ATD's is acceptable during rebound.

4. Body-to-Wall/Furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. In most cases, the representation of the structure would be more rigid and have less deflection under load than the actual installation on the airplanes. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

5. Thoracic Trauma: Thoracic Trauma Index (TTI) injury criteria must be less than 85, as defined in 49 CFR part 572, subpart F. Thoracic trauma index data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

6. Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

7. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

8. Seat Positions: All seat positions need to be occupied by ATD's for the longitudinal tests.

9. End Closures: All side-facing seats require end closures or other means to prevent the occupant from translating off of the seat.

10. Longitudinal Tests: For the longitudinal tests conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

a. One test will be required with ATD's in all positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). For configurations with a wall or bulkhead immediately forward of the forward seat position on the sofa, a SID ATD will be used in the forward seat position and a Hybrid II ATD(s) or equivalent will be used for all other seat locations. For configurations without a wall or bulkhead immediately forward of the forward seat, Hybrid II ATD's or equivalent will be used in all seat locations.

b. One test will be required with Hybrid II ATD's or equivalent in all positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

11. Vertical Test: For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's or equivalent will be used in all seat positions.

Issued in Renton Washington, on December 7, 2000.

/s/ Donald L. Riggin
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service, ANM-100